Open vs laparoscopic hernia repair for unilateral inguinal hernia, are there better outcome with development in skills?

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Inguinal hernia refers to the protrusion of bowel or omentum through a weakening in the abdominal wall – specifically the inguinal canal. The gold standard treatment for bilateral inguinal hernia is laparoscopy. However, there is presently no consensus in the gold standard surgical method of unilateral inguinal hernia treatment. Unilateral inguinal hernias have been shown to be effectively treated in both open and laparoscopic fashion. Intrigued by this dichotomy in treatment for the ailment, we investigated the effectiveness of both procedures over two time periods (2000-2005 vs. 2012-2017) for the treatment of unilateral inguinal hernia. The primary outcome measure that was used for comparison was recurrence rates. The 2000-2005 period exhibited a lower recurrence rate for open procedure whereas the 2012-2017 period favoured the laparoscopic technique. However, these observed differences were not statistically significant in favouring one technique over the other.

Introduction

The word 'hernia' is derived from the Latin word 'rupture' and describes the event where an organ protrudes through the cavity in which it should be contained (Sangwan et al., 2013). There are various types of hernias such as inguinal, ventral, femoral, umbilical, epigastric, hiatal, which can be described based on their characteristics including direct, indirect, acquired, congenital, reducible and nonreducible (Miserez et al., 2007). If an abdominal hernia cannot be reduced, the herniated contents can become incarcerated in the abdominal wall (Hjaltason, 1981). This requires surgical intervention as an incarcerated hernia can become life threatening if blood flow is cut off to the externalized tissue and the hernia becomes strangulated (Gallegos et al., 1991).

We have chosen to specifically focus on unilateral inguinal hernias. An inguinal hernia is defined as a protrusion of tissue from the abdominal cavity through a weakened space in the inguinal canal. Inguinal hernias occur ten times more frequently in men than women, with 27% of males experiencing herniation in their lifetime (Jenkins and O'dwyer, 2008). An inguinal hernia occurs above the inguinal ligament and can be subdivided into direct and indirect variants. Direct inguinal hernias occur when bowel projects through a weakened section of abdominal muscle along the inguinal canal medial to the inferior epigastric vessels (Stein, 1946). An indirect inguinal hernia occurs when the opening of the inguinal canal remains patent after birth, allowing passage of bowel through the canal lateral to the inferior epigastric vessels (Gilbert, 1989). Corrective surgery is required when simple conservative management by reduction and watchful waiting fails.

This paper focuses on the recurrence rates in unilateral inguinal hernia surgical repair, specifically Open approach and the Laparoscopic approach. The Lichtenstein open method involves using a polypropylene mesh to bridge the defect rather than sewing the two sides together (Schmedt et al., 2005). Hernias can also be repaired laparoscopically by passing the endoscope and instruments through one, three or four small incisions, dissecting the area and repairing the hernia with mesh from the inside of the abdomen. We wish to investigate whether recurrence rates have changed from the years 2000-2005 and 2012-2017 in order to establish whether procedural and technological improvements in both surgeries has led to better patient outcomes.

Methods

PICOS

The study will examine research articles published during the time periods of 2000-2005 and 2012-2017 inclusive in order to compare the aforementioned surgical techniques. The study aims to determine if there is a significant difference between the two techniques in rates of hernia recurrence. Furthermore, we will also examine the costs associated with the procedures as a secondary outcome. We performed a systematic review, utilizing Cochrane, Web of Science, EMBASE, and Ovid Medline databases to retrieve research articles. The search strategy was based on using keywords that related to inguinal hernia, the surgical techniques used for its treatment, and complications following the surgery. The surgical techniques that were used included laparoscopic (total extraperitoneal and transabdominal preperitoneal techniques) and open incision procedures. The surgeries were separated into these two categories, in an attempt to compare the complications rates - primarily recurrence rates post-surgery. The complete search criteria can be seen in Figure 1.

Selection Criteria

A subject librarian carried out a search on Cochrane, EMBASE, Ovid Medline and Web of Science using the keywords; 'unilateral inguinal hernia', 'laparoscopic surgery', 'open surgery', 'inguinal' and 'hernia', which yielded an initial result of 3,776 articles. These were uploaded to endnote and the duplicates were removed. The remaining papers were then uploaded to Covidence™ (Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia; available at www.covidence.org) for further screening. The articles were initially screened based on the title and abstracts. After this initial selection process, complete versions of the selected publications were retrieved for a full text review. The entire selection process was performed by two independent authors in duplicate and any conflicts were resolved by a third member of the group to prevent selection bias.

We included articles that investigated the long term outcomes of patients undergoing unilateral inguinal hernia surgery. The papers were required to compare laparoscopic and open surgical procedures and report recurrence rates amongst the two techniques in the long term. Studies were excluded if they did not report the outcomes of unilateral inguinal hernias, if the studies were not available in English, and if the study was published outside of the target years (2000-2005 and 2012-

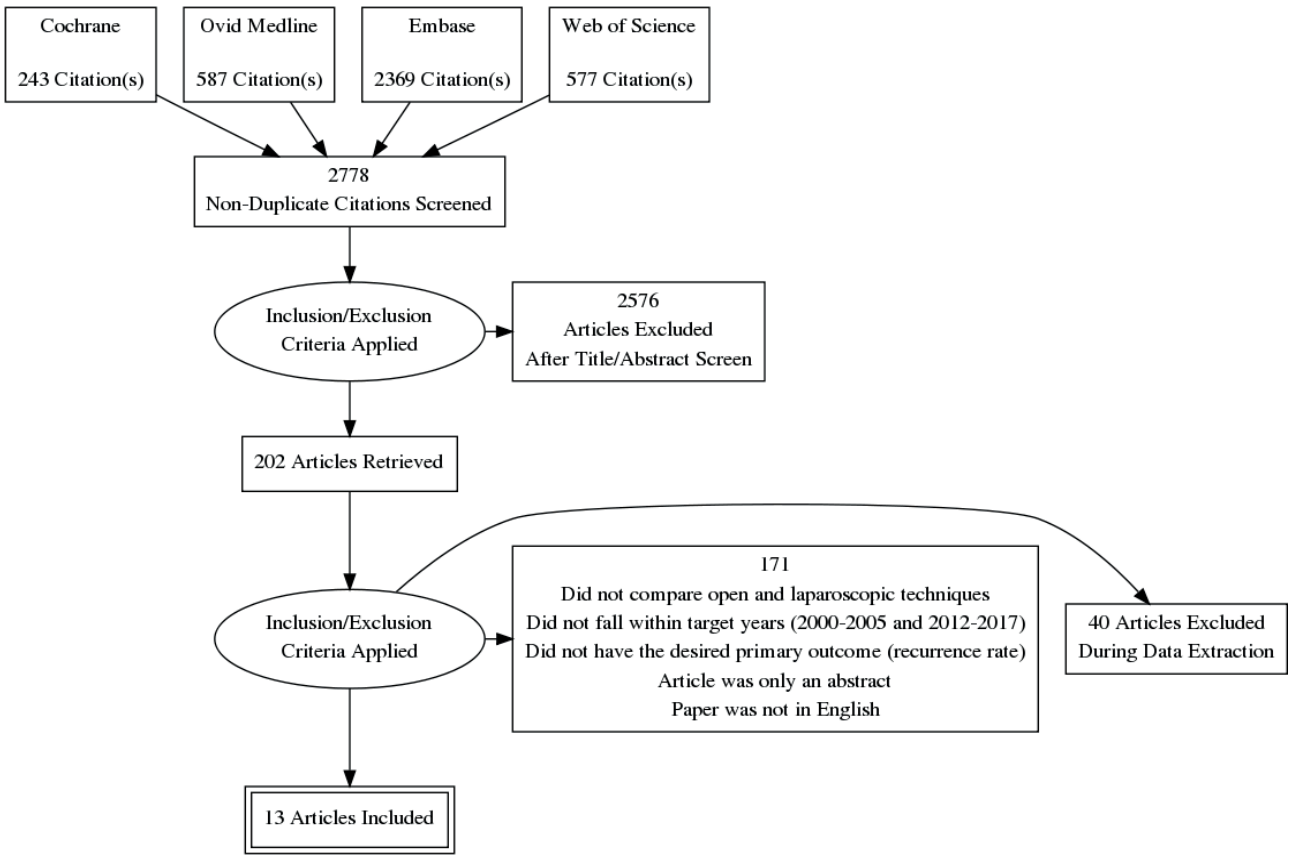

Figure 1: PRISMA flow diagram for article selection for the systematic review

2017). Any publications that were presented as only abstracts or conference proceedings were not included, as it was not possible to extract the necessary information required for the overall analysis.

Data extraction

Included studies were first separated into two groups according to publication year: 2000-2005 and 2012-2017 inclusive. The data from the selected studies were extracted according to the type of procedure performed. Data extraction primarily focused recurrence rates between open and laparoscopic surgeries performed as well as costs in these populations.

Data Analysis

The collected data from the papers selected for analysis were assessed according to the time of publication. The data sets were analysed by comparing recurrence rates from open and laparoscopic procedures and forest plots were created for each time-frame.

Results

The selected search criteria yielded thirteen articles that fulfilled our inclusion standards. The total number of subjects in the eight studies conducted between 2012 - 2017 was 1,208,024 with a range from 185 to 125342 patients. The five studies conducted between 2000 - 2005 had a total of 4,433 subjects with individual studies having 50 to 1777 subjects.

The cumulative results from the selected studies demonstrated that the recurrence rates are not constant. However, the

Author	Year	Procedure Type	No. of unilateral hernias	Recurrence Rates	Cost
McIntosh et al.	2001	OH: 302 LH: 308	610	OH: 0 LH: 1.9%	OH: £788.89 LH: £1112.64
Wright et al.	2002	OH: 151 LH(TEP): 149	210	OH: 2% LH: 2%	LH > OH due to costs of instruments
Lal et al.	2003	OH: 25 LH:25	50	OH: 0% LH: 0%	
Winslow et al.	2004	OH: 1476 LH: 301	1777	OH:5% LH: 3%	
Neumayer et al.	2004	OH: 834 LH: 862	1696	OH : 4.9% LH : 10.1%	

Table 1: Papers included from the time period 2000 - 2005 OH – open hernia repair; LH – laparoscopic hernia repair;

TAPP – transabdominal pre peritoneal hernia repair; TEP – Total extra peritoneal hernia repair;

Table 2: Papers included from the time period 2012 - 2017

Author	Year	Procedure Type	No. of unilateral hernias	Recurrence Rates	Cost
El-Dhuwaib et al.	2013	OH: 117,234 LH: 8,108	125, 342	OH: 2.1% LH: 4%	-
Abbas et al.	2012	OH: 97 LH(TAPP) : 88	185	OH : 5.2% LH: 3.4%	-
Wang et al.	2013	OH: 84 LH: 84 (TAPP); 84 (TEP)	252	OH: 4.76% LH: 0%	OH: 5852±864 RMB TAPP: 9504±1132 RMB TEP: 9351±985 RMB
Khan et al.	2013	OH: 44 LH(TAPP) : 46	90	OH: 12% LH: 3%	OH: 6180±1409.73 PKR LH(TAPP): 13040± 2166.15 PKR
Li et al.	2013	OH: 952 LH: 504	1456	OH: 0.6% LH: 1.2%	-
Ashfaq et al.	2014	OH: 59 LH:44	96	OH: 3% LH: 0%	-
Vigneswara et al.	2015	OH: 91 LH: 380	337	OH:2.5% LH: 2.5%	-
Zhu et al.	2017	OH: 923 LH: 202	998	OH: 0.46% LH: 0.64%	-

OH – open hernia repair; LH – laparoscopic hernia repair; TAPP – transabdominal pre peritoneal hernia repair; TEP – Total extra peritoneal hernia repair; RMB – Chinese yuan; PKR – Pakistanirupee

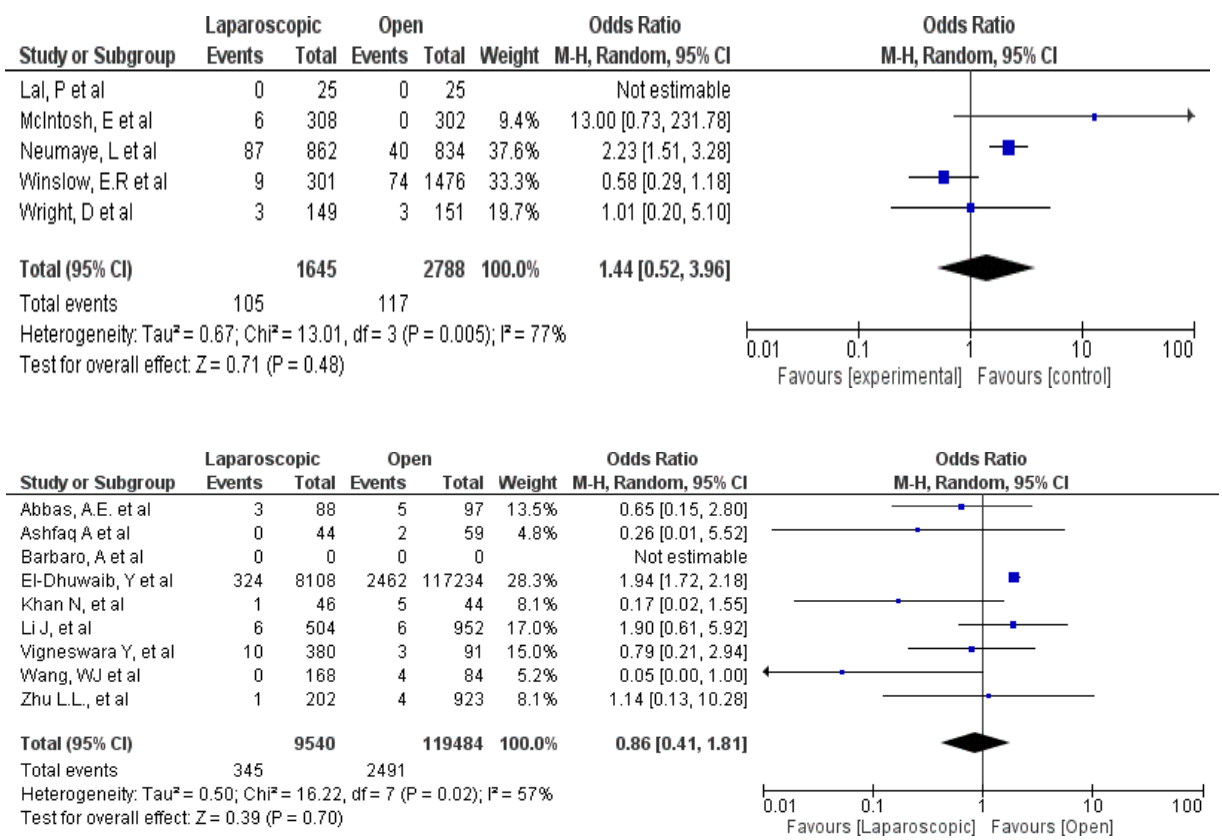

Figure 3: Forest plot depicting the data extracted from the 2012 – 2017 papers

majority of papers from Table 1 indicate that between 2000-2005 recurrence rates were lower in open inguinal hernia repairs compared to laparoscopic techniques. This is highlighted most clearly by Neumayer et al. who demonstrated a recurrence rate of 4.9% in open repairs compared to 10.1% in laparoscopic repairs (Neumayer et al., 2004). Furthermore, when examining the papers that assessed the costs associated with the procedures, it is evident that the laparoscopic repair was more expensive, likely attributable to the cost of the instruments used in the procedure and lack of availability of resources.

In the data sets obtained from 2012-2017 inconsistency in recurrence rates is also observed. The majority of the studies reported either lower recurrence rates for the laparoscopic procedure or similar recurrence rates, suggestive of an improvement in post-surgical complications from the 2000-2005 time period. El-Dhuwaib et al. show a lower recurrence rate for the open procedures, however this data takes surgical procedures conducted over a large time period starting from early 2000 (El-Dhuwaib et al., 2013). For this reason, the results from the study need to be assessed carefully as it has surgical data that coincides with both of our time periods of interest. Khan et al demonstrated a substantially higher recurrence rate in open hernia repairs (12%) in comparison to laparoscopic repairs (3%), however their sample size was small (Abbas et al., 2012). The costs for the surgeries were also examined whenever possible and it was consistently shown that laparoscopic repair remains more expensive than open repair.

Figure 2 depicts the five studies included from between the years 2000 to 2005. The result of this meta-analysis is that the results did not display a statistically significant difference between the open and laparoscopic techniques - summary evaluation crosses the line of no effect (P = 0.48) but still favouring the open technique. The level of heterogeneity in the data from 2000-2005 is 77%. According to the data collected as shown in Figures 2 and 3, it is evident that there were higher recurrence rates in the laparoscopic method between 2000-2005 before the paradigm shifts towards lower recurrence rates in the laparoscopic method between 2012-2017. The odds ratio interprets the odds of recurrence of symptoms in laparoscopy and illustrates lower recurrence rates between 2012-2017 compared with 2000-2005. The data does not meet statistical significance since the 95% confidence interval crosses the midline making it non-equivocal.

Discussion

This study investigated which surgical procedure for unilateral hernias had the most favorable outcomes. Studies published in 2000-2005 and 2012-2017, comparing open versus laparoscopic surgeries for unilateral inguinal hernias were identified and analysed. This project focused on recurrence rates to determine which procedure type that had the more effective outcomes. While research has shown that in treatment of bilateral hernias, the laparoscopic method has been recommended as the 'gold standard', studies examining a potential best approach for unilateral hernias are limited because of the lack of widespread consensus (Wauschkuhn et al., 2010; Saleh et al., 2014).

Based on the results above, in the years 2000 - 2005, the open method was favoured when compared to the laparoscopic, as it produced lower recurrence rates and was more cost effective. This may be due to the fact that during this time, laparoscopy was relatively new and limited to surgeons who were experienced and trained to use it. Conversely the open method was readily available and had been used extensively by general surgeons up until the invention of laparoscopy.

For the years 2012 - 2017, the trend shifts towards laparoscopy as the preferred approach. Over the course of this time period, laparoscopy produced lower recurrence rates when compared to that of the open method. The number of laparoscopic hernia repair procedures has increased and therefore more surgeons have gained experience and training in the laparoscopic procedures. This has led to a shift in the favoured treatment as it is less invasive (minimizes infection risk due to exposure), is associated with a shorter duration of hospital stay and has been shown to minimize postoperative pain (Cavazzola and Rosen, 2013).

Although both time periods favour different approaches, the statistical evidence for both remains insignificant. There are a number of potential causes for this insufficient statistical evidence. Firstly, the search criteria for this topic was highly specific, each study had to include an open vs. laparoscopic comparison in recurrence rates for unilateral inguinal hernias during the specific time periods stated above which narrowed down the eligibility of studies from the original 3776 papers found from the search. It is clear that laparoscopy has come long way since its introduction into surgery, however the results of this study highlights that in the case of repair of unilateral inguinal hernias, more comprehensive comparative research needs to be carried out in order to concretely determine whether laparoscopy is ideally the best method of treatment for unilateral hernias in most cases.

Conclusion

Our study attempted to elicit the safest surgical approach when treating unilateral inguinal hernias, comparing the open method to a laparoscopic approach using recurrence rates as primary outcome and cost as a secondary outcome. Research papers selected focused on these outcomes during two time periods (2000 – 2005 and 2012 -2017).

Based on our research, it was apparent that between 2000-2005 shifted towards the open technique, whereas between the years 2012 – 2017 surgeons favoured the laparoscopic technique. However, in neither case was statistical significance shown following statistical analysis. We ultimately concluded that more comprehensive comparative research is required to unequivocally state that the laparoscopic technique is superior to the open for the repair of unilateral inguinal hernias.

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